Introducing the Canadian Information Centric Workspace Concept

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ABSTRACT

Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) is an evolving information operations (IO) concept in the Canadian Land Force. ISTAR provides the commander with a system to collect and process required information for producing intelligence on the threat and knowledge on the environment during operations, as well as knowledge needed to identify, acquire and engage targets. The various processes used to collect and analyze the information are the result of numerous individual systems some of which have only been recently introduced in the field while many others are still in development as a result of advances in the information age. This compendium of systems makes ISTAR a "System of systems", as opposed to a single system. This paper presents the new Canadian information centric workspace concept that provides a more coherent information management approach to better support the Commander in both its tactical intelligence and operations activities at brigade level. The info-centric workspace concept aims at offering a seamless collaborative environment enabling the ISTAR staff to perform their tasks using different applications / services through a standardized Human Computer Interface (HCI).

INTRODUCTION

The explosion of information technologies has set in motion a virtual tidal wave of change that is in the process of profoundly affecting both organizations and individuals in different aspects. This means that military organizations also face a tidal wave of transformation of an irresistible force [1] that, at the same time, offers unprecedented challenges [2]. The military does not have much choice. Resisting transformation is futile. However, accepting transformation in only the technological aspect is also not a valid option. Today, improvements in processing power and communications means make information technologies even more attractive and cost-effective for organizations to implement. Willingly or not, we have entered the information age. As Owens puts it [3], for a long time, information has been inseparable from commanders, command structures, and command systems. Information is no longer the prerogative of commanders and command structures but has become necessary to all participants in a mission [4].

Many armies have by now learned that when introducing Command and Control (C2) information technologies (IT) to their organization, a series of changes occur in a number of areas and if these changes are not properly taken into consideration in the planning stages of the transformation process, then these changes will become hindrance in the accomplishment of the missions thus planting the seeds for the overall rejection

Paper presented at the RTO IST Symposium on "Military Data and Information Fusion",
held in Prague, Czech Republic, 20-22 October 2003, and published in RTO-MP-IST-040.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **00 MAR 2004**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **Introducing the Canadian Information Centric Workspace Concept**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Defence R&D Canada (DRDC Valcartier) System of Systems Section 2459 Pie-XI Blvd North Val-Belair (Quebec) G3J 1X5 CANADA; DMR Consulting A Division of FUJITSU Consulting 2960 Blvd Laurier, Office 400 Sainte-Foy (Quebec) G1V 4SI CANADA**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM001673, RTO-MP-IST-040, Military Data and Information Fusion (La fusion des informations et de données militaires)., The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**35**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

of the system. The areas that will be affected and need to be considered in the transition have been regrouped by Champoux in her thesis [5] into three main perspectives as illustrated in Figure 1 and are: a) Systems, b) Users, and c) Processes. What is meant by “systems” are the hardware and software components related to Information Technologies (IT) that, when put together according to a set of requirements and specifications, make up IT systems. The term “users” refers to the people and their skills, education, training, experience and organization. The term “processes” refers to the Doctrine, Standard Operating Procedures (SOP), and Techniques, Tactics and Procedures (TTP). The successful business solution will be the one achieving best harmony between the three perspectives: Users - Processes - Systems.

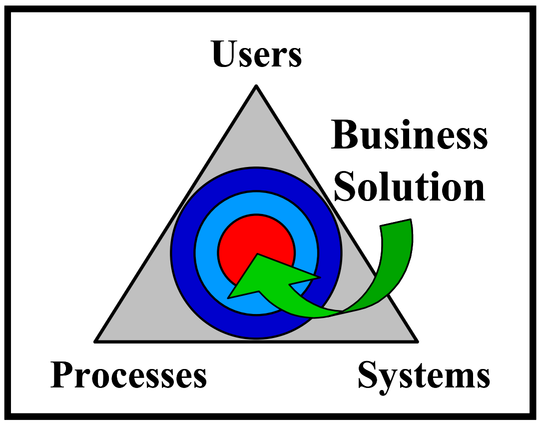

Figure 1: System of Systems Harmony Triangle: Users – Processes – Systems.

THE CANADIAN ISTAR CONTEXT

In the Canadian Land Force Information Operations doctrine [4], the definition of ISTAR (Intelligence, Surveillance, Target Acquisition, and Reconnaissance) is: “a system where information being collected through systematic observation and sensing is integrated with that collected from specific missions, and is processed in order to meet the commander's information requirements.” ISTAR integrates sensor capabilities and the intelligence process that provides the direction and processing of sensor data. Therefore, the ISTAR constitutes a “System of systems” that is managing and fusing data to serve the command function through integration of a wide range of sensing capabilities and information functions and processes. Considering this “System of systems” approach, the complexity of introducing automated data fusion tools is strongly related to the nature of the available information, its pattern of dissemination, and the organizational adaptation capacity.

If the Canadian Land Force is to be successful in fielding an efficient ISTAR “System of systems”, many ingredients have to work together. We thus need to address many factors. As with any other system, the ISTAR System encompasses the three main perspectives explained earlier: the systems, the users and the processes by which these users use the systems. Based on the results obtained by Champoux [5] in a different context, the authors recognize the fact that all three perspectives have to be addressed concurrently by the Canadian Land Force for a successful implementation. Experience shows that the introduction of new information technologies and their capabilities into organizations is potentially risky unless accompanied by a planned change transition in a number of key areas. This paper discusses two of the aspects illustrated in Figure 1: a) the new ISTAR business concept addressing the “processes” perspective, and b) the necessary transformation in the "systems" perspective for a successful business solution implementation. This paper will concentrate on the ingredients needed to create the conditions where the data fusion tools can be successfully introduced while exploiting information age technologies.

THE INGREDIENTS FOR "PROCESSES" TRANSFORMATION

The ISTAR system must be able to effectively collect, process and act upon information to ensure the commander has enough of the knowledge he needs to conduct a faster and higher quality decision-action cycle. The information should be collected and processed from data into useable knowledge so that the commander can develop an understanding of the current situation in order to prepare future operations. Since, data fusion processes are to be found imbedded at different levels within many of these systems ranging from collectors up to analysis centers, this movement of information must be achieved through a rigorous process stream that allows for the most effective transformation into an intelligence product. One challenge is to bring these data fusion processes to work collaboratively as distributed processing centers.

Within the operational context, it is assumed that ISTAR produces intelligence in response to commander's requirements as defined within the Operational Planning Process (OPP) [6], the Intelligence Preparation of the Battlefield (IPB) [7] and the Targeting Process [6]. These processes provide direction on the employment of the ISTAR system and provide the framework within which ISTAR information and intelligence products are exploited. As mentioned by Cain and Walker in their study of ISTAR processes [8], few countries in the American, British, Canadian and Australian (ABCA) coalition have developed a complete intelligence system comparable to the emerging Canadian ISTAR system. Lessons learned from allied ISTAR systems are useful in pointing the way toward an improved Canadian ISTAR system. However, in these systems, the volume of information to be collected and acted upon is increasing with the inclusion of modern sensors on the battlefield. Further use of existing systems is likely to overwhelm the analysts to the point that modern sensing technology may become a hindrance to effective decision-making.

The principal goal of an ISTAR capability is to collect and transform information into knowledge for the decision-makers. The idea of the information sphere comes to hand when one tries to illustrate the ISTAR business process. The ISTAR doctrine [5] speaks of Global Information Environment (GIE) while the knowledge management literature refers to the information sphere. According to Knight [9], « the info-sphere is a theoretical representation of all the information that exists. From this vast selection of information, the decision-maker is seeking "operational information", that is, the relevant information that is needed to make decisions in a given operational context. In reality, the operational information is scattered all over the info-sphere, and in many cases one will not be able to identify a piece of information as "operational info" until it is needed. Recognizing the term "operational information" is the starting point in building a systematic approach to finding, processing and using all of the information that must be made available to decision-makers.» From an information system designer's perspective, the objective is to build a system that maximizes the efficiency and value of the actions "to access, collect and assess information" with the minimum of friction so that decision-makers get the intelligence they need (Figure 2). If organizations really want to exploit all of the richness available from the info-sphere, the authors believe that we must get away from the mechanization of processes and adopt a global approach taking into consideration the three perspectives of Figure 1.

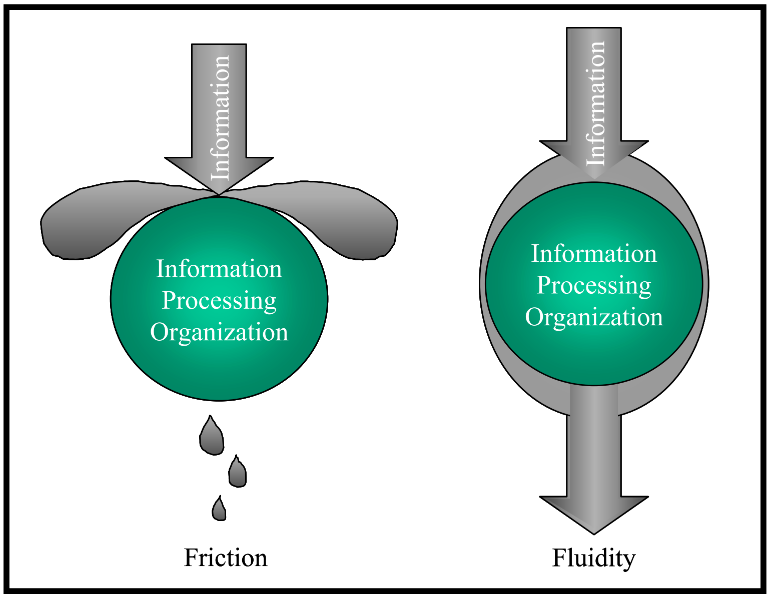

Figure 2: The Process Transformation enables organizations to reengineer their information processes by removing friction while adding more fluidity.

By reviewing the current "Processes" involved in ISTAR, it became clear to the authors that because the overall ISTAR process is not an independent process from Command and Control (note that "Command and Control" is a military term for leadership and management), an improved ISTAR business process must be introduced to facilitate the processing of information and to manage the tasking and re-tasking of ISTAR system components. Operational forces and decision-makers are constantly coming across gaps in their knowledge that need to be filled, and they need a mechanism to raise these requirements in a systematic manner. A similar mechanism is also required for ISTAR analysts that are constantly sifting and comparing information as they often identify information gaps that need to be filled in order to make sound assessments. In addition to these *ad hoc* information needs, a standing set of information requirements governing routine activities and planned operations must be in place and managed at all times. Rather than having separate techniques and procedures to manage all of these requirements, a common feedback or requirements loop is needed to properly task the collectors and ensure that responses are provided in a timely and prioritized manner. In order to render the ISTAR "System of systems" more efficient as a whole, the authors have found that a new ISTAR function needs to be created: an ISTAR Coordination function. This new ISTAR function will provide more than information brokerage services in terms of providing appropriate information to requesters but also providing a resource management capability for information collection. Not surprisingly, this coordination function is in line with the definition of the Joint Directors Laboratories for data fusion level 4: Process Refinement [10]. This process refinement is an element of resource management where adaptive data acquisition and processing are used to support mission objectives. This provides the rationale for having a specific ISTAR Coordination Function composed of two closely tied teams: an Information Collection Management Team and an Intelligence-Surveillance-Reconnaissance Assets Management Team.

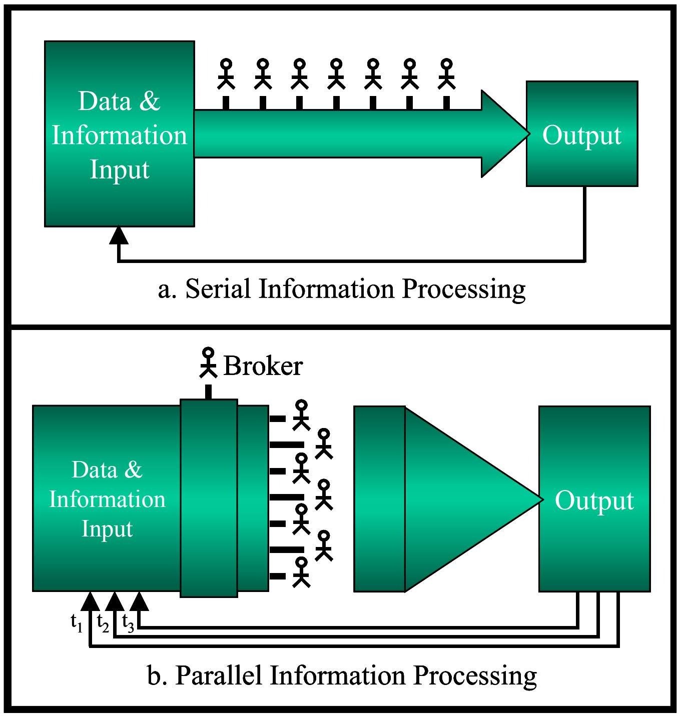

Figure 3: Organizations employing information workers in parallel processing (collaborative sharing) topology proven to produce output of better quality and quantity than the serial processing topology.

To introduce an efficient ISTAR Coordination function, we took the approach to implement a seamless collaborative environment based on a shared network architecture. This will allow all functions comprising ISTAR to work together and enable the different analysts to perform their tasks and extract information using different applications through a standardized Human Computer Interface (HCI). This defines the "information centric workspace" concept. This concept also assumes that core application components will plug into the workspace environment in a similar fashion irrespective of the military functions being integrated. The transformation brought about by the "information centric workspace" concept is now possible because of new modern capabilities associated with information technologies and most notably those associated with information sharing, collaboration, and visualization. We expect this concept will improve our ability to bring all of our information and all of our knowledge and experience to bear. Amongst other things, these modern capabilities enhance the possibility to do collaborative fusion and analysis e.g. parallel information processing (Figure 3) that has proven to increase the situation awareness of all connected information workers from a recent study by Blain [11]. It is now understood by the Canadian ISTAR team that concurrent information processing such as data and information fusion requires collaborative work under asynchronous information management. Thus, the conditions necessary for success of ISTAR in the Information Age revolve around an organization characterized by asynchronous information flows that are not unduly constrained, where the key parts of individual components can be self-synchronized allowing collaborative fusion and analysis (Figure 3). These are the characteristics associated with true integrated processes. One objective is to put the Information Centric Workspace concept accessible at all levels in the chain of information transformation so that fusion and analysis can be performed whenever and by whoever requires it and that the results become input to the next transformation iterations in the "System of systems". The authors believe that to successfully implement automated data fusion tools into C2 systems, it is necessary to adopt such a "System of systems" approach. In this way, the whole System design could take into consideration the needs of all users in the information transformation chain.

The conditions for transformation in the "processes" perspective imply the reengineering of some information processes if organizations are to really exploit the richness of the info-sphere. What is needed in the Canadian ISTAR context is to bring the notion of information brokers to manage the balance between information requirements and information collection. This balance is related to Process Refinement of the JDL data fusion level 4. Hence, the ISTAR Coordination function provides information brokerage services coupled with resource management for information collection. Important evolutions in information technologies had to occur to enable information sharing, collaboration, and visualization. These evolutions made possible the emergence of the new concepts of data centric and network centric warfare which in turn enabled the emergence of the info-centric workspace. These evolutions allow the possibility to do collaborative fusion and analysis in distributed processing centers. The info-centric workspace approach when coupled with the data-centric and the network-centric organizations should have a multiplier effect on the availability, quality, timeliness and management efficiency of the information. However, before being able to reap the fruits from the information centric workspace concept, it is also necessary to investigate the other ingredients needed to implement such a concept from the "Systems" perspective.

THE INGREDIENTS FOR "SYSTEMS" TRANSFORMATION

Over past decades, the military have developed several different vertically specialized functions that supported different Command and Control business processes. When developing information systems to support these military functions without first possessing an overall architectural vision or a road map of all involved functions and processes, it is often discovered too late that these systems while correctly supporting their vertical military functions do not necessarily provide an integrated "System of systems" solution. In this situation, the Canadian Land Forces inherit "stove-pipe" systems that become cumbersome to use and a nightmare to support both from a training and maintenance perspectives. From lessons learned, the requirement for interoperability between systems became the priority. One of the early attempts at integration was through the processing of formatted structured messages that allowed a first level of interoperability. Although promising this approach was not sufficient at the end because of the lack of a reference model such as an agreed common information exchange data model enabling true data sharing capability between systems. While the processing of formatted structured messages was being developed and implemented, communications capability continued to improve in terms of speed, bandwidth and connectivity. Now that systems can be networked together, the development of the Network-Centric Warfare (NCW) concept [12] in the US became possible. This NCW concept is based upon a new model for automated support to command and control (part of "process" transformation), one that features sharing of information (synchronization in the information domain) and the collaborative processes necessary to achieve a high degree of shared situational awareness. Alberts [13] in another publication independently reinforces Blain's [11] findings about collaborative work sharing that «An additional benefit is the increase in richness of the awareness created. This increase in richness occurs as a result of the efforts to reconcile differences in fact and/or perspective that result from (1) more sources of information, (2) increased sharing of information, and (3) collaboration. »

Chaum [14] goes even further by arguing that to fully exploit such NCW concept, there must exist a common reference data model: «The net-centric exchange of operational context, requires a shared top-down information reference model to ensure consistency of content and meaning, without which there is no shared understanding. Properly chosen, a reference model can conceptually link all elements of the battlespace and provide a framework for sophisticated automated reasoning and effective Joint and Coalition communications.» This means that if an Army wishes to exploit the new capabilities offered by information age technologies, it must do at least four things: a) develop an information business vision, b) develop a top-down "System of systems" architecture supporting the vision, c) adopt both a data-centric and d) a network-centric system approach.

Canada has adopted a new ISTAR vision and it is developing a top-down "System of systems" architecture supporting that vision. A first revolution occurred when the Canadian Army decided to impose a data-centric approach to all Land Force systems through the adoption of the NATO Land Command and Control Information Exchange Data Model (LC2IEDM) to promote contextual information (operational context) exchange and interoperability between all systems in 2001. A second similar revolution occurred when the ISTAR project decided to also adopt a collaborative network-centric approach at Battle Group and Brigade command levels in 2002. Yet, this is not enough. We need to go a step further. What is now proposed is a further evolution of these concepts to the Human Computer Interface (HCI) and applications level with the adoption of a collaborative info-centric workspace environment.

This further evolution is nevertheless facing one major constraint in that the workspace environment must work in a distributed environment while being flexible enough to support different decision making processes in different combat situations. The Commander of the Army clearly stated this objective for the approval of the ISTAR project: "ISTAR is to enhance the capability to exercise effective Command & Control guarantying success in all operations." The information-centric workspace will contain a set of tools that will be used as necessary and appropriate depending upon the role and the level of command of the user in the information production chain. A difficult objective to achieve will be to deliver the info-centric workspace at all levels in the information chain so that the same set of tools is available to perform fusion and analysis in support of the intelligence and SA. In order to improve the commander's ability to understand and conduct operations, he must be better informed just not more informed. This is the difference between "too much" and "just enough" information to enable the creation of the right knowledge about and sufficient understanding of the situation [15]. A shift to an intelligent pull approach, where the users get to shape their information space, clearly reduces the probability that users will be overwhelmed with information of little or no relevance. On the other hand, producers of information cannot possibly know all of the uses of the information they collect, nor the importance of the various details or lack of details, so posting before processing is not a solution. Perhaps, giving the possibility to information workers to obtain on-demand underlying data details may alleviate the danger of information bottlenecks.

One of the anticipated benefits of the workspace approach is to provide more flexible work sharing to the organization but at the expense of more user training. For example, in the case of a serial information processing organization (as illustrated in Figure 3), the users learn one specific function or occupy one specific position therefore requiring less training but providing less flexibility for the organization. In this scenario, reduced flexibility also means reduced adaptability to different operational contexts (from the classical low-medium-high level of conflicts to the asymmetrical type of warfare) with different levels of resources to perform the work. In the case of a parallel information processing organization, when using an info-centric workspace, it is expected that one person receiving proper training with the different tools will be able to perform a multitude of tasks but may have to take a longer period of time to accomplish them. This type of organization will increase its flexibility to handle the tasks but may not be able to afford the extra user training required because of lack of resources (trainers and trainees). In the ISTAR TD project, we anticipate that this situation will be alleviated by the implementation of the Electronic Task Support Services (ETSS) tools as an integral component of the workspace. More on the ETSS can be found in another paper presented by Champoux [16]. Furthermore, to reduce the training time required by the users and to maximize usability of the system, some tools of the Workspace must have a consistent Human Computer

Interface (HCI). This implementation results in an aggregation of fully integrated tools available in the workspace as opposed to a set of individually developed stove-pipe systems brought together on a desktop. The information workers will be provided with an enhanced capability to adapt the tools to fit their operational needs and their specific tasks.

Understanding that this new paradigm was a necessary deviation from the old method of acquiring a functional capability, the first step in the project was to develop a "System of systems" Architecture (SoSA). A preliminary study was conducted to model current and future systems in order to extract the common services required by the majority of them. The results of the study produced a clear vision for the environment and a clear path to achieve it. It was recommended that this path be evolutionary instead of being revolutionary so the design of the solution had to take into consideration as many of the current operational and future systems as possible including their limitations. Finally, a "System of systems" architecture was proposed and endorsed by our army sponsors. Figure 4 presents the high level view of the Canadian ISTAR Info-Centric Workspace concept supported by nine groups of services and a data service layer regulating the access to five types of databases for non-structured, structured and special data formats.

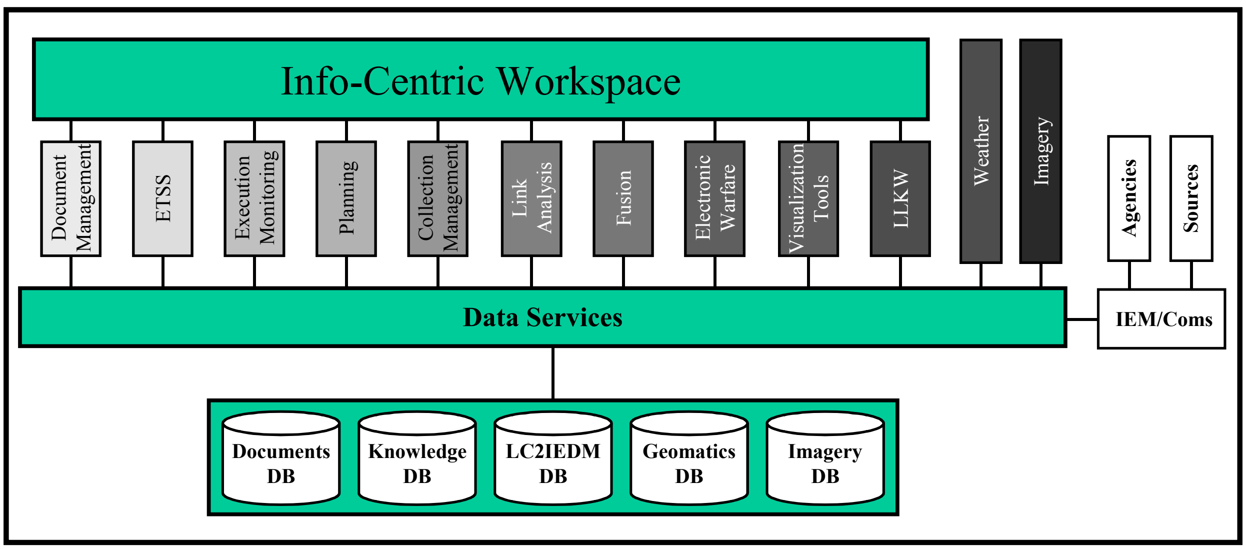

Figure 4: The proposed ISTAR Information Centric Workspace System of Systems Vision.

The SoSA definition is relatively simple to accomplish if the mission and objectives of the System are clearly defined *a priori*. This means that the organization must have a clear vision of where the transformation process will lead it. If one is not rigorous during this phase, System Principles and Orientations for system design can translate into a lot of wasted effort [17]. As an example, if a given system has specific requirements and approach for managing security access to data and processes then it is more than likely that they will impact all of the software development. So building a "System of systems" represents a challenge in determining the necessary and appropriate Principles and Orientation to the problem. In the domain of science and engineering the notion of "System of systems" has always existed. In biology, for example, a human cell is a system in the human body that itself is a system in the animal kingdom. Then that animal kingdom can be considered a system of systems. That is to say that in order to properly address a problem, one has to adopt the right perspective [18]. Once identified, the next step consists in a de-composition into components and services that make up the different parts of the "System of systems". Even though this represents a classical and well-known approach to system design, its success is still an art rather than a science and is the purview of a few dedicated professionals who have refined their art through years of experience.

The ISTAR project obviously brought elements of science in the equation by adopting methodologies and standards into its project management procedures. Understanding that standards are not sufficient by themselves, a suitable methodology is mandatory to provide for proper synchronization and harmonization amongst team members through the use of a common language and agreed checklists that are especially useful to manage large projects distributed over different physical locations. Nevertheless, success rests upon the core team of selected people that must be knowledgeable in that kind of military business. Methods and methodology ensure the quality of the products, hence their transition ability into the field but the validity of the solutions found is based on the team's expertise with its capacity to solve complex problems. However, adaptation to a particular context requires people knowledgeable about the specific operational requirements in order to document the right kind of information. Composing with all these factors is the science of project management.

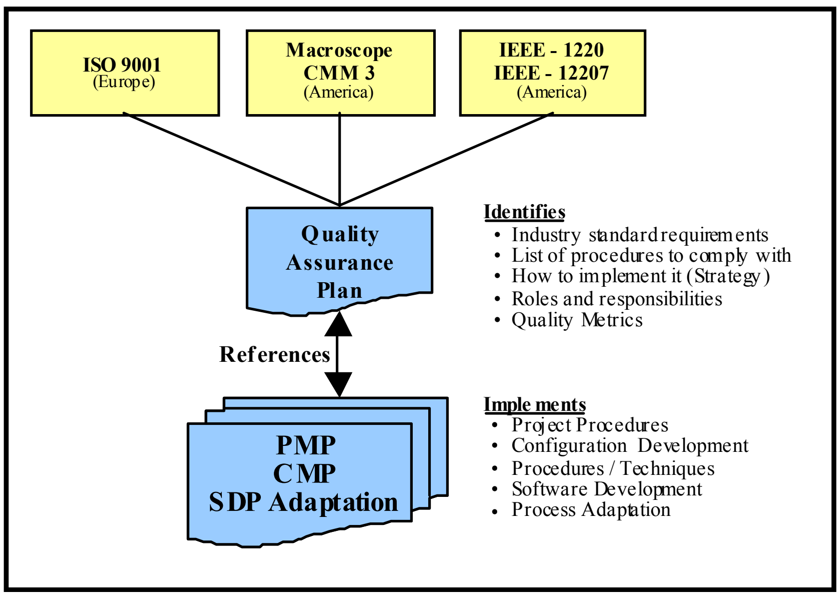

Figure 5: Canadian ISTAR Project Adopted Methodology.

In view of the particular complexity of the SoSA and of the nature of the work to be performed, a methodology was thus chosen and adapted to the Canadian Department of National Defence (DND) context. Figure 5 illustrates the different references that were used in order to build the ISTAR final methodology. The selected methodology was based on "Macroscope™" [19] from Fujitsu Consulting, which is one recommended by Gartner's Group [20], and the Computer Maturity Model (CMM) level 3. Some adaptations were done to take into consideration different standards such as IEEE-12207 (software development life-cycle) [21] and IEEE-1220 ("System of Systems") [22]. From this adapted methodology, the software development and implementation techniques were developed including a Quality Assurance Plan (QAP), a Project Management Plan (PMP), a Configuration Management Plan (CMP) and an adapted Software Development Plan (SDP).

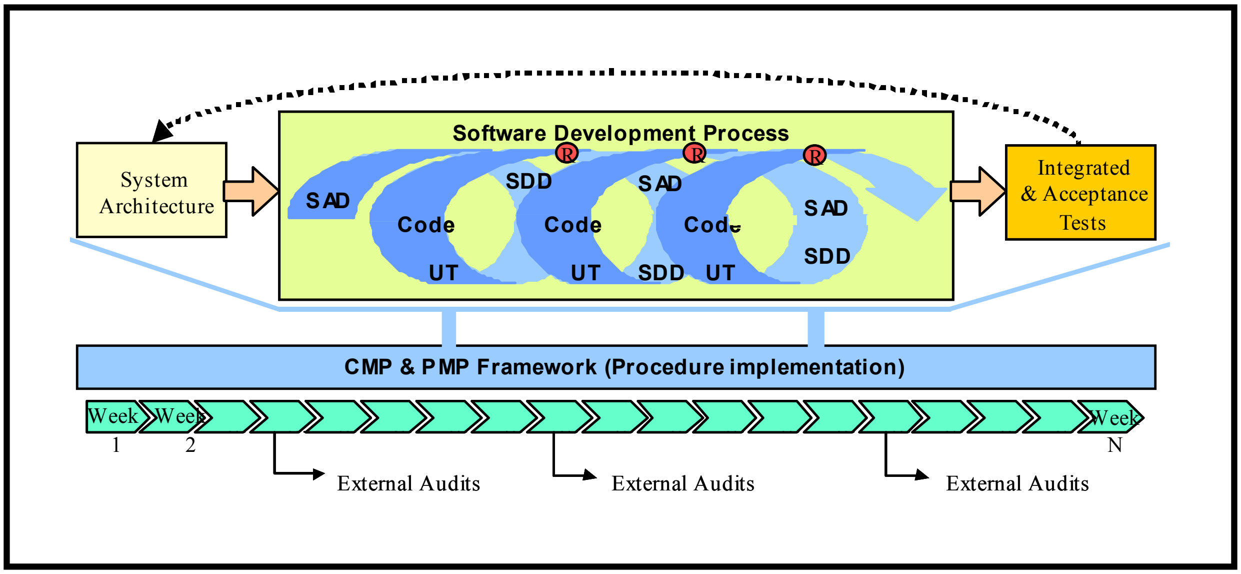

Figure 6: Software Proto-Cycling Adopted Methodology.

Figure 6 illustrates the proto-cycling approach that has been retained. This proto-cycling technique combined with a rigorous Configuration Management Plan (CMP) (including validation tests throughout the development process using test beds in appropriate context) provides a formal incremental system release approach that is better than the traditional waterfall model. This technique allowed all the different perspectives to evolve at the same time and to provide a balanced "System of systems" phased delivery that had periods of 12 to 18 months instead of multi years. This aspect of system delivery becomes a very important issue when fielding complex command and control systems.

One of the most interesting features of "Macroscope™" in this context is the use of Joint Application Development (JAD) sessions with subject matter experts [23]. The JAD technique also had to be adapted to a context of limited user availability. During the JAD sessions, the three main perspectives illustrated in Figure 1 had to be considered and weighed: the users and their capability to absorb the new technology, the procedures and processes that need to be adapted and the diverse required functionality of the systems. This JAD approach had the benefit of providing a continuous training environment for the users, of facilitating user acceptance, and of tailoring the system to user needs. This technique enabled all the different perspectives to evolve at the same time providing a balanced "System of systems". By performing JAD sessions in this fashion, it provided two additional benefits: a) the means to do effective and efficient requirements capture, and b) a value rating for the different requirements was possible thus reinforcing the capacity to perform true value management [24, 25] during the project. What our experience demonstrated is that methodologies and standards to perform this kind of work exist and are available providing they are properly adapted to each particular development effort.

We have seen so far that the project took a top-down approach, it identified a vision, it adopted a methodology, methods and standards, it designed a solution that took into consideration the current and selected future system components, articulated a SoSA, and finally, through its proto-cycling methodology had taken a phased delivery approach. This approach combined with the parallel information processing context as discussed earlier yielded to a development in two phases. Phase I of the project covers the Collection Management (CM) Service, phase II will address three other different aspects: a) development of an Analysis and Fusion Tool Kit that will be distributed in the infrastructure, b) the integration of link analysis service, and c) the enhancement of the Battlespace visualization service currently available.

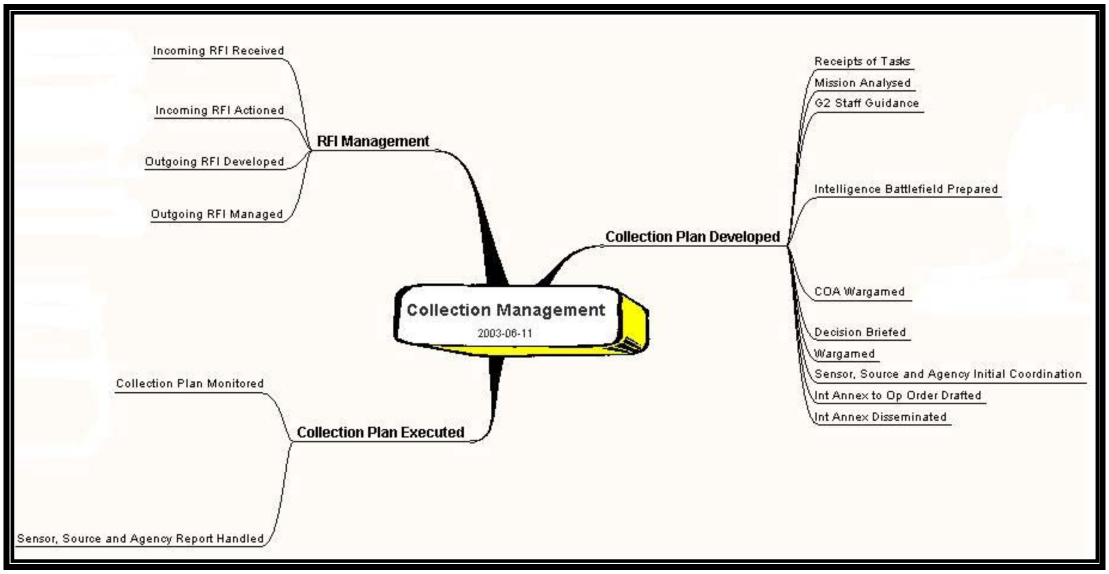

Figure 7: The Collection Management Processes (Levels 0, 1 and 2).

Since the vision developed for ISTAR required the development of the information broker function first, the emphasis was put into the development of the Dynamic Collection Management Service of the ISTAR Coordination Function. Through JAD workshops with user representatives, the Collection Management (CM) process was captured and documented using knowledge management techniques and tools. The captured CM processes are illustrated in Figure 7. The three main processes for CM are: Collection Plan Developed, Collection Plan Executed, and Request for Information Management. These processes have been refined further many levels down and provide a fundamental knowledge element for the ETSS. Again, it was discovered that information technologies when properly introduced in a balanced way (recalling Figure 1) do not change what the users are trying to accomplish but rather change the way to accomplish it. While procedures tend to structure how you do things in an orderly fashion, we found that, when properly implemented, the system could better support the event driven humane way of doing things which is not always so orderly.

Once the different methods in which the CM tasks are executed under different situations have been captured, the information is fed into the ETSS [16]. This service enables on-line contextual help so that when software modules (for each iteration) are tested, the users can readily visualize the procedures, techniques and products related to each specific task. With this overall methodology, the project team can make sure that all the ingredients making a “System of systems” do evolve in synchronization and harmony. Ultimately the ETSS will hold enough information as to provide an on-line contextual help structured in a knowledge network linked to the application. In addition, the JAD technique was used to enrich the ETSS to support Computer Based Training for users on-line. In one controlled experiment, this approach demonstrated that the average time for training could be reduced by a factor of up to five times the traditional tutorial training [11].

Finally, there is another important facet we have not covered so far in this paper. We said that when introducing IT to an organization, processes and procedures will have to be adapted or to be changed.

In military organizations, this refers primarily to Doctrine and secondarily to Standard Operating Procedures and Techniques, Tactics and Procedures known as SOP and TTP. Alberts [13] hits the mark when he wrote: «Military organizations and individuals feel bound to honor doctrine and thus create a mindset and environment not conducive to disruptive innovation. This is because when the nature and distribution of information changes, radical new ways of doing business and complications in the old ways of doing business emerge. …This is why it is so vital that the doctrine community be involved at the beginning of the new concept development process and to stay involved throughout this process.» Also involving the doctrine community early will also facilitate the key process of embedding doctrine into the new systems that in turn will contain and help support the evolution of doctrine. As already experienced in the Canadian Army with the establishment of the new Lessons Learned Knowledge Warehouse (LLKW) [16] on the army infrastructure network, the doctrine is changing from one of publishing "the way" it should be done to a dynamic process of collaboratively learning and sharing best practice.

In summary, based on the current results of our work, we are tempted to believe that the conditions for transformation in the "systems" perspective imply that to fully exploit the new capabilities offered by information age technologies, a military organization like an army should consider at least these five things: a) develop an information business vision, b) develop a top-down "System of systems" architecture supporting the vision, c) adopt a data-centric vision with a common reference model, d) field a distributed network-centric capability and e) embark on an information-centric workspace system approach. The necessity to choose a suitable methodology supported by recognized standards coupled with a project team composed of knowledgeable people are the cornerstones for success. We have selected a methodology for proto-cycling software development based on a phase delivery approach. This approach had the benefit to enable on going user training, user acceptance, and system's tailoring all at the same time during the validation testing sessions. This technique allowed all the different perspectives to evolve at the same time and to provide a balanced "System of systems" phased delivery that had periods of 12 to 18 months instead of multi years.

CONCLUSION

The definition of a perfect "information centric workspace" is when all of the services existing in a "System of systems" are all working on the same distributed network in a manner as to offer a seamless collaborative environment. This enables the different analysts to perform their tasks and to extract information using different services through a standardized Human Computer Interface (HCI). The info-centric workspace approach also provides major improvements in facilitating system's component integration from a user training and a maintenance points of view. The info-centric workspace aims at managing information to avoid information bottlenecks and to improve the commander's capability to understand and conduct operations.

We have seen that ISTAR supports the command function through the integration of a wide range of sensing capabilities and information functions and processes. ISTAR constitutes a "System of systems" that encompasses three main perspectives: the systems, the users and the processes by which these users use the systems. The authors believe that to successfully implement automated data fusion tools into C2 systems, it is necessary to adopt a "System of systems" approach. Another condition of success is to move away from developing systems the old fashion way towards a new information driven "System of systems" approach. In this way, the whole System design could take into consideration the needs of all users in the information transformation chain. These are the ingredients needed to create the conditions where automated data fusion tools can be successfully introduced. The next objective of our research group will be to design, develop and integrate specific fusion tools supporting the intelligence analysts involved in ISTAR processes.

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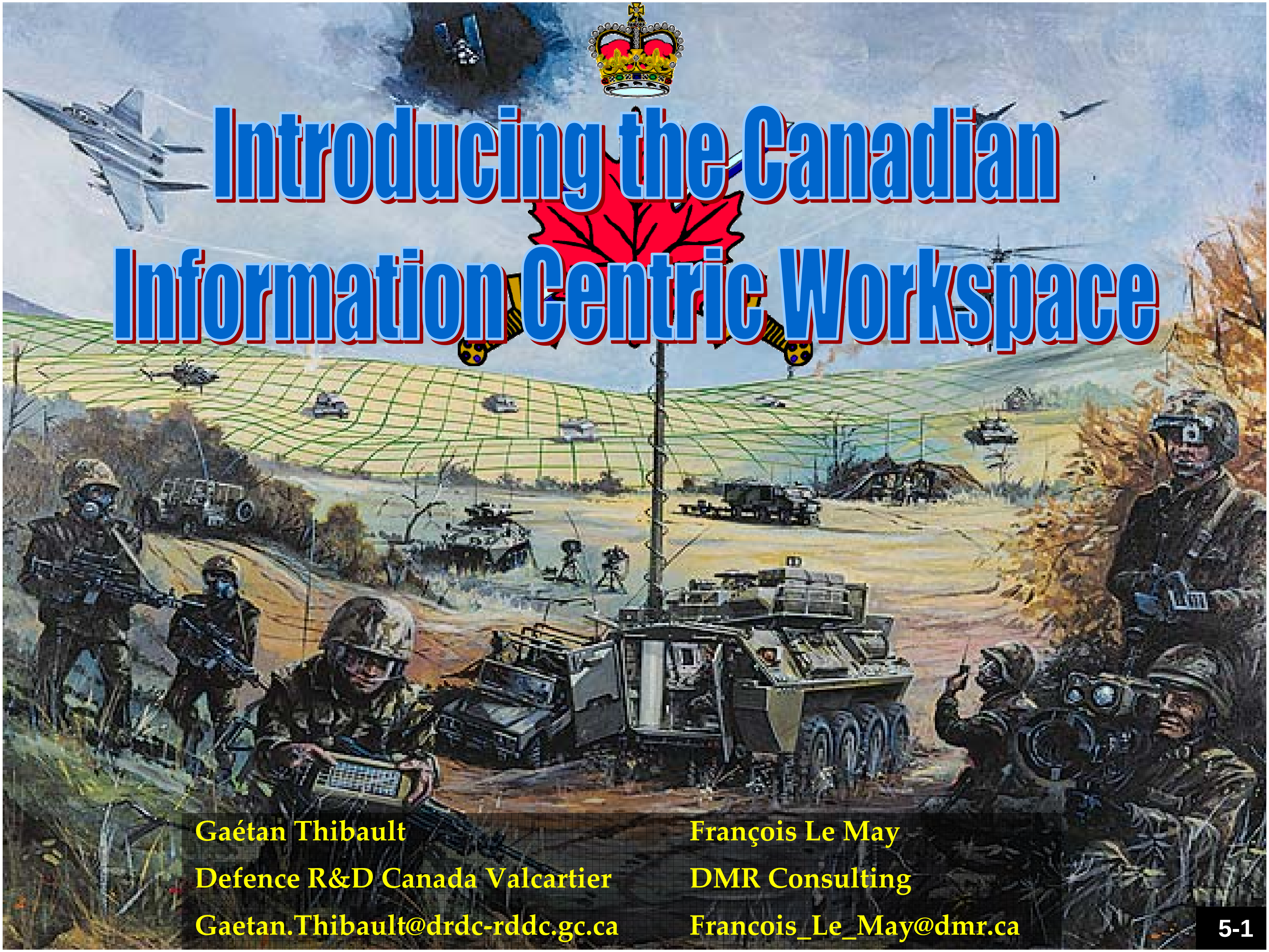

Introducing the Canadian Information Centric Workspace

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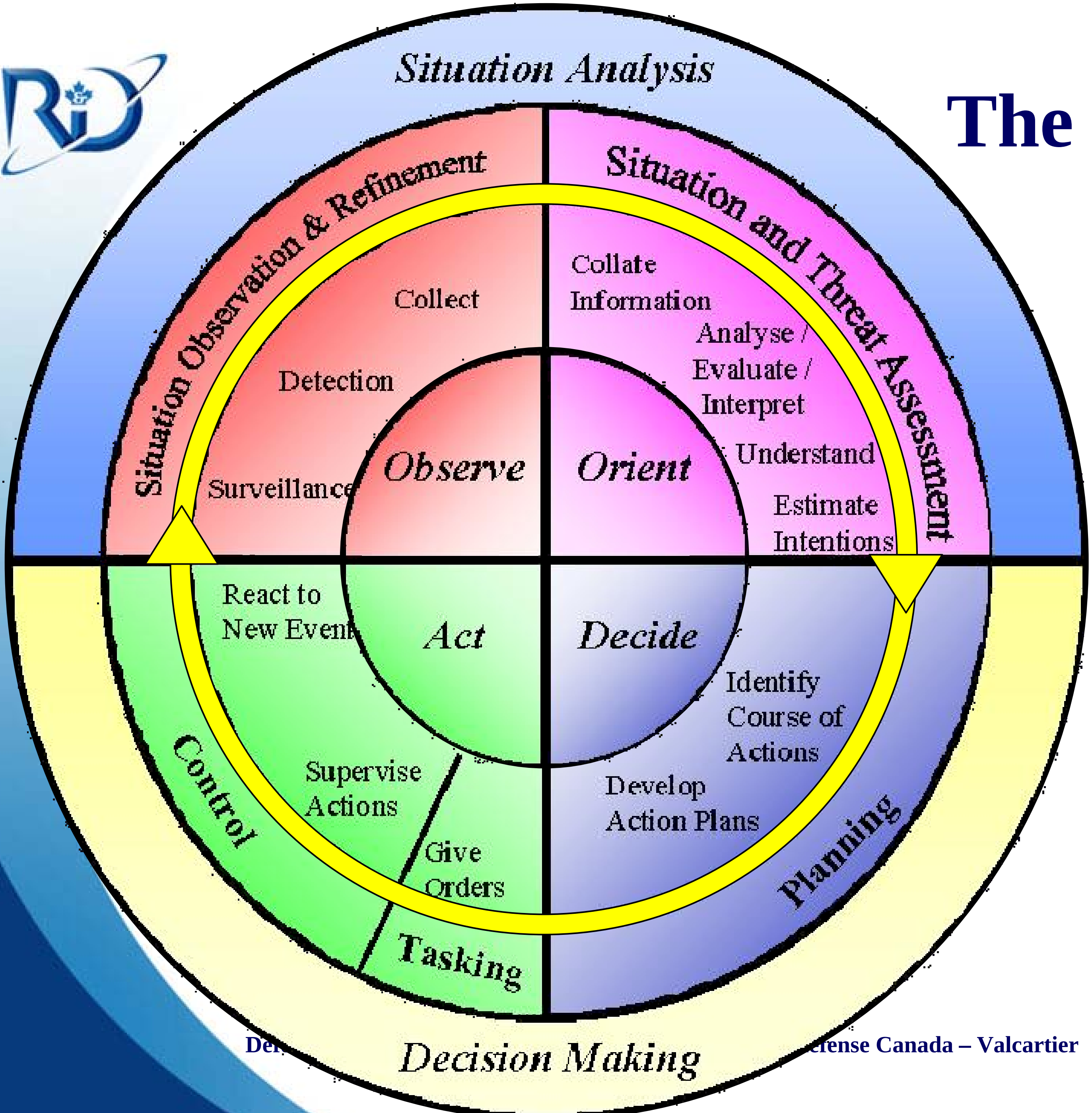
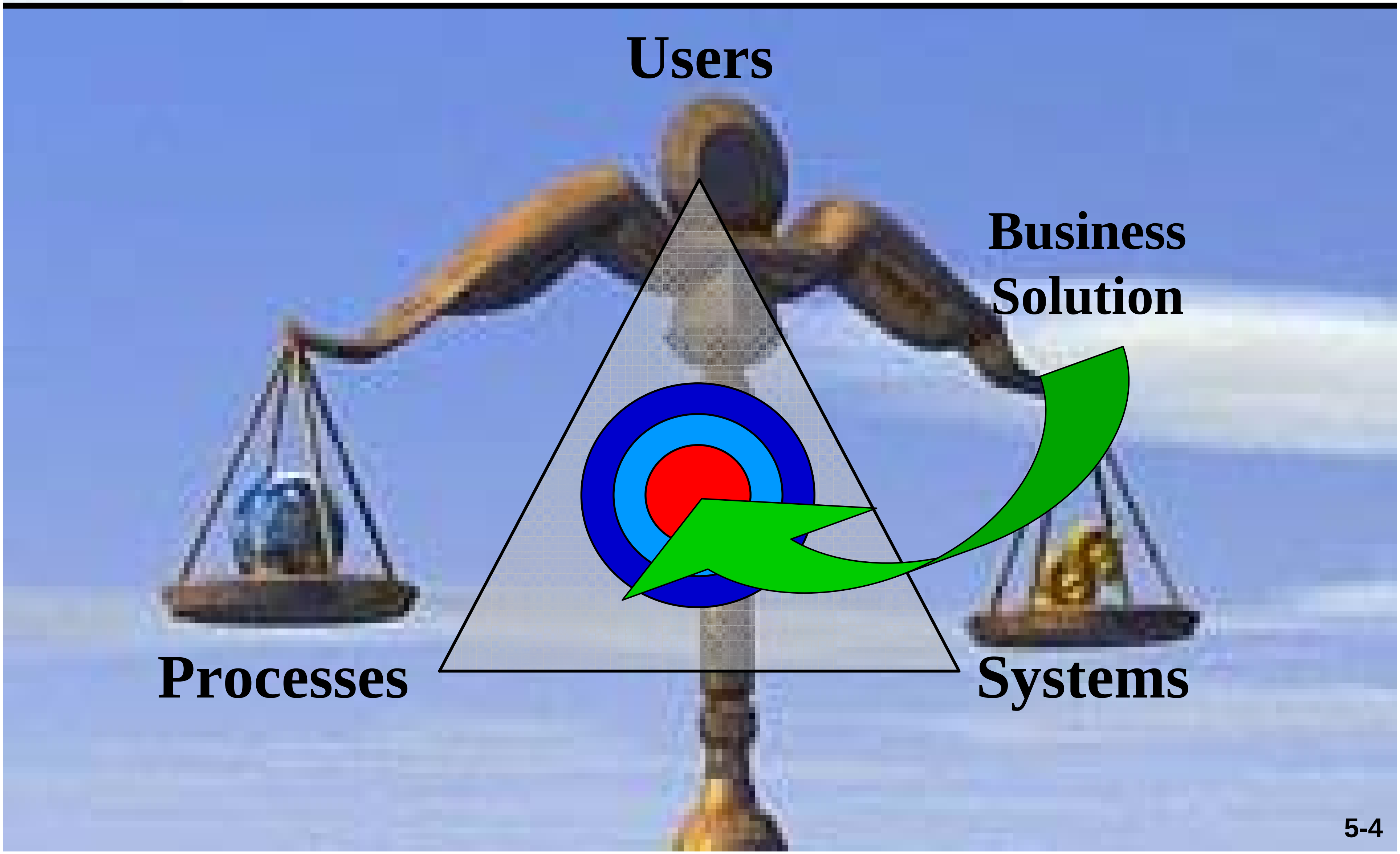
Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR)

- The role of ISTAR is to integrate the intelligence process with the surveillance, target acquisition, and reconnaissance assets in order to improve a Commander's Situational Awareness and to cue manoeuvre and strike assets.

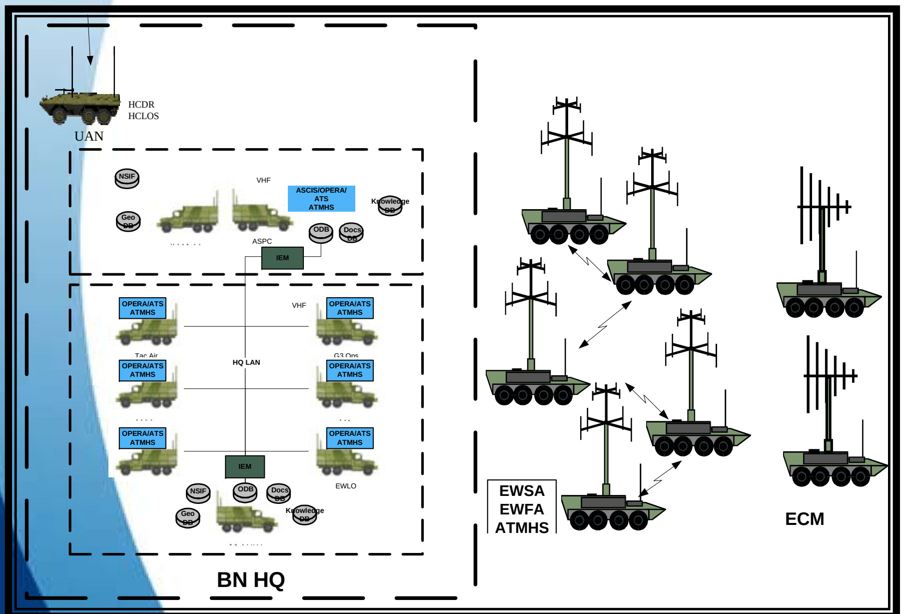
The Observe, Orient, Decide, and Act, (OODA) Loop



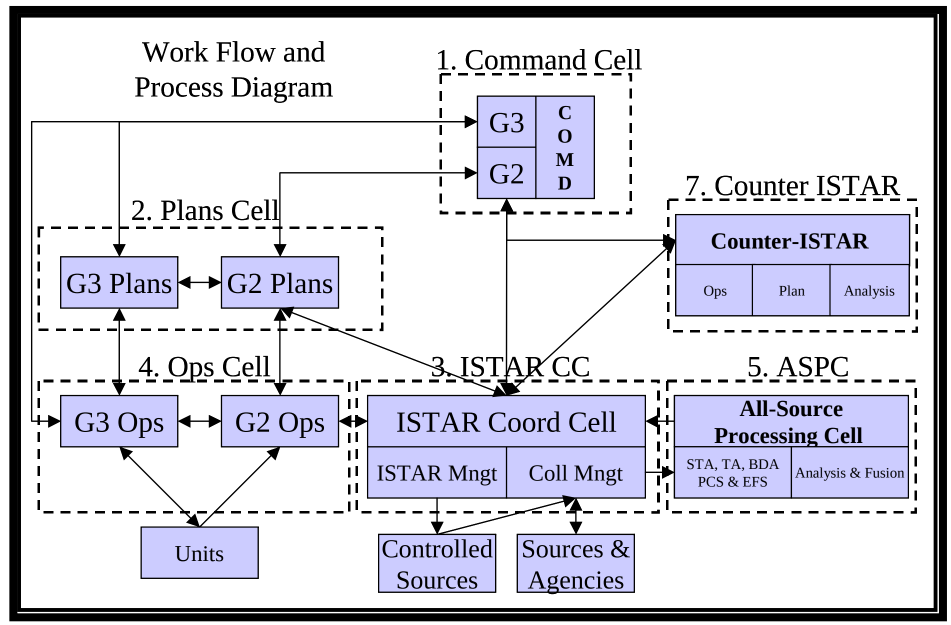
PERSPECTIVE AND BALANCE
System of Systems Harmony Triangle

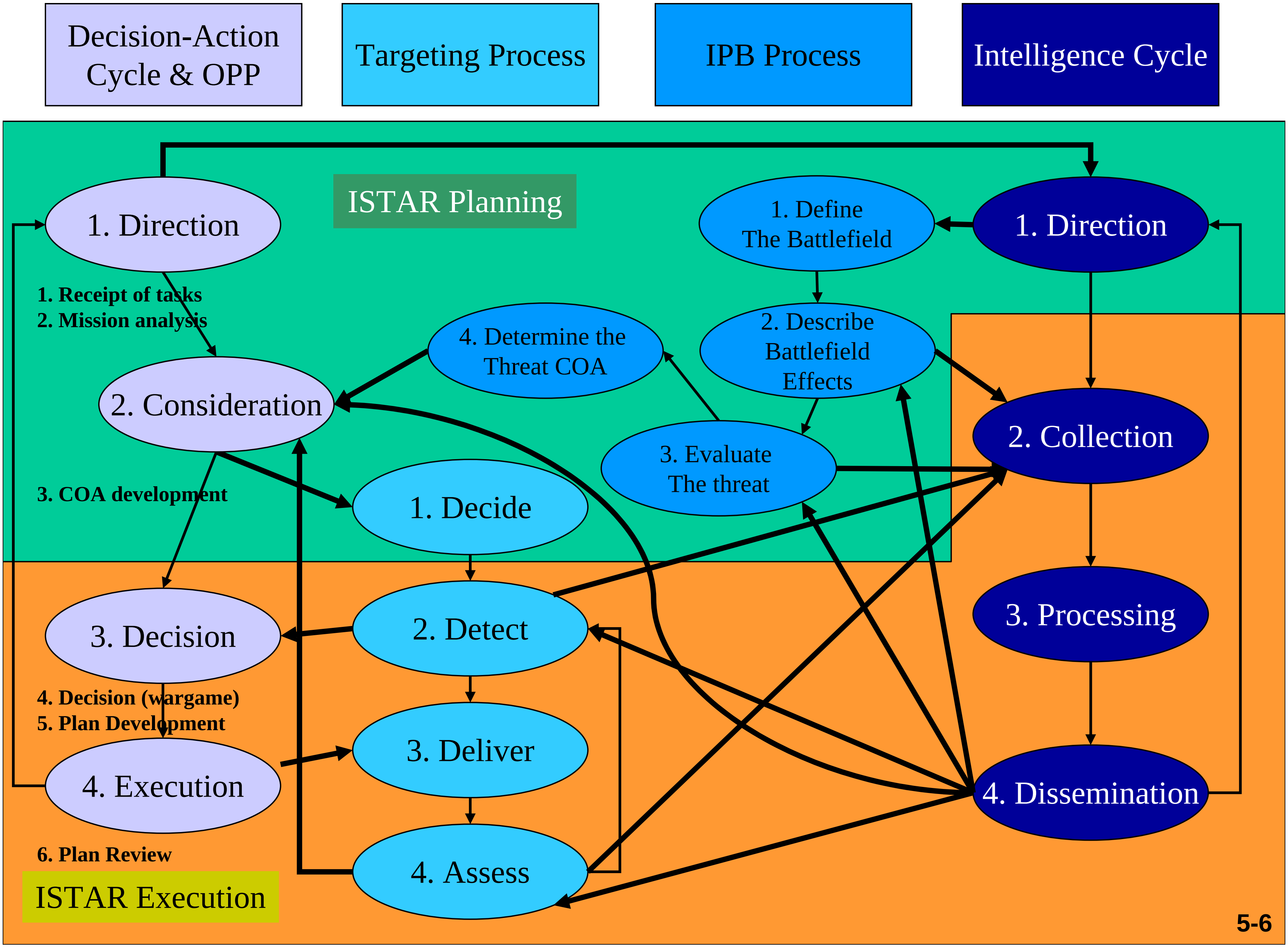


Systems

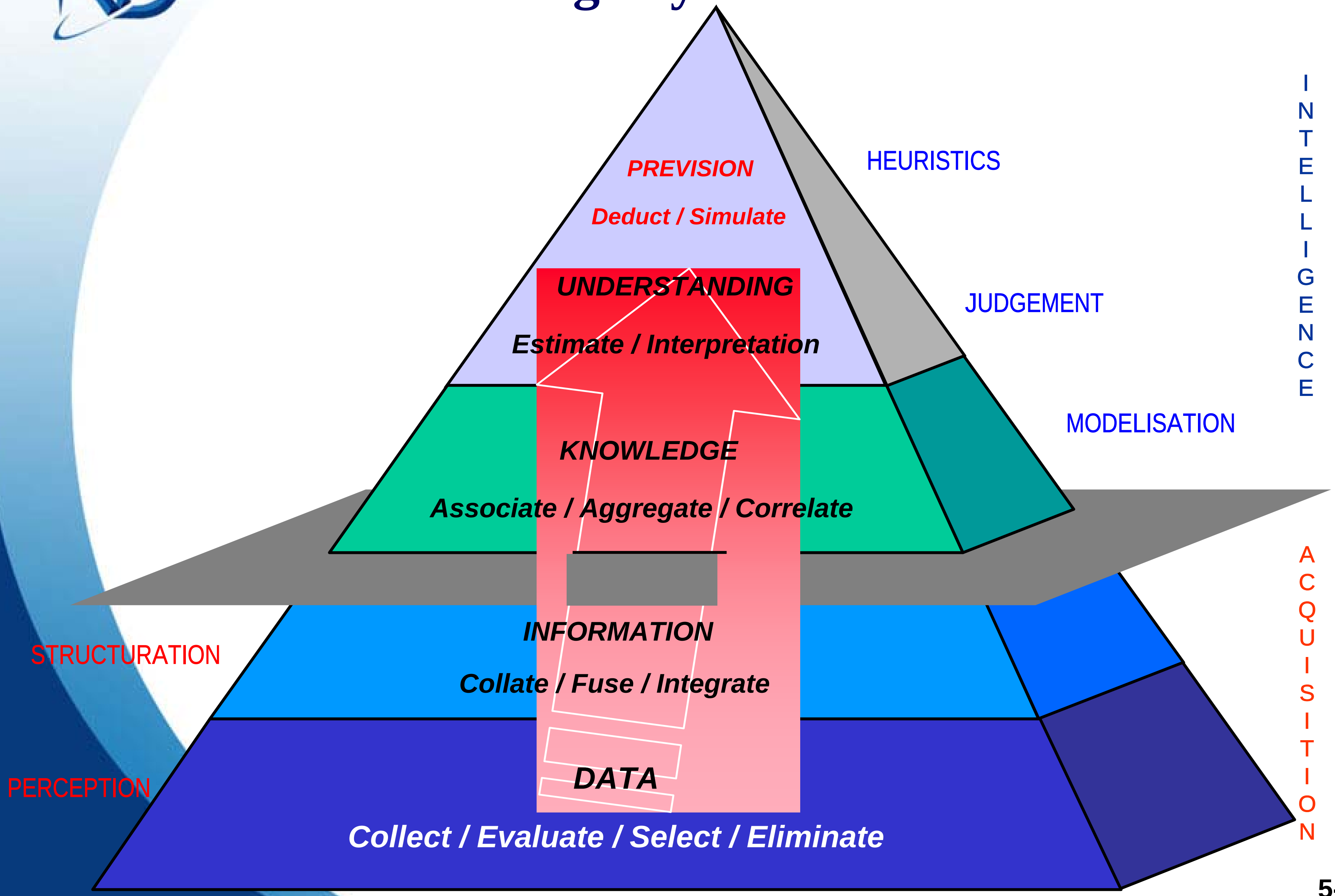


Processes

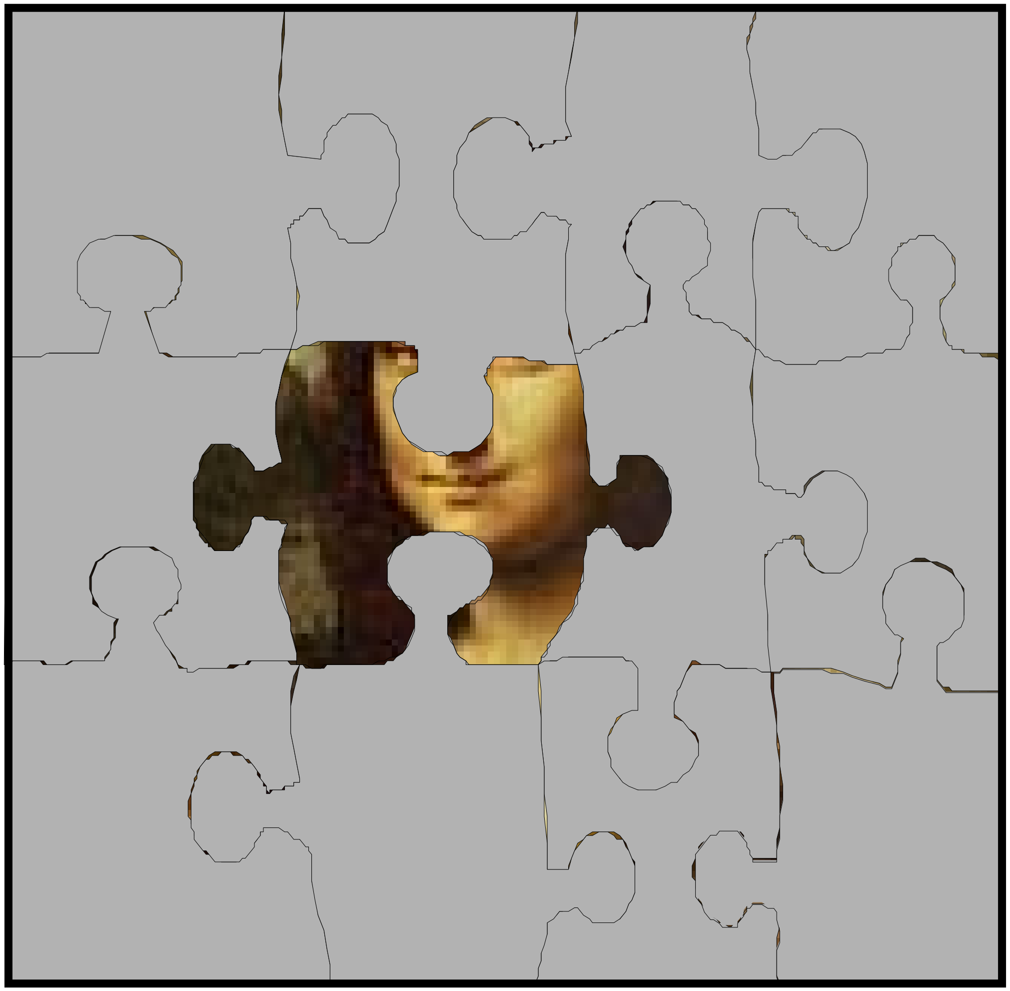



Decision-Action Cycle & OPP
Targeting Process
IPB Process
Intelligence Cycle
ISTAR Planning
1. Direction
1. Receipt of tasks
2. Mission analysis
2. Consideration
3. COA development
3. Decision
4. Decision (wargame)
5. Plan Development
4. Execution
6. Plan Review
ISTAR Execution
1. Decide
2. Detect
3. Deliver
4. Assess
4. Determine the Threat COA
1. Define The Battlefield
2. Describe Battlefield Effects
3. Evaluate The threat
1. Direction
2. Collection
3. Processing
4. Dissemination

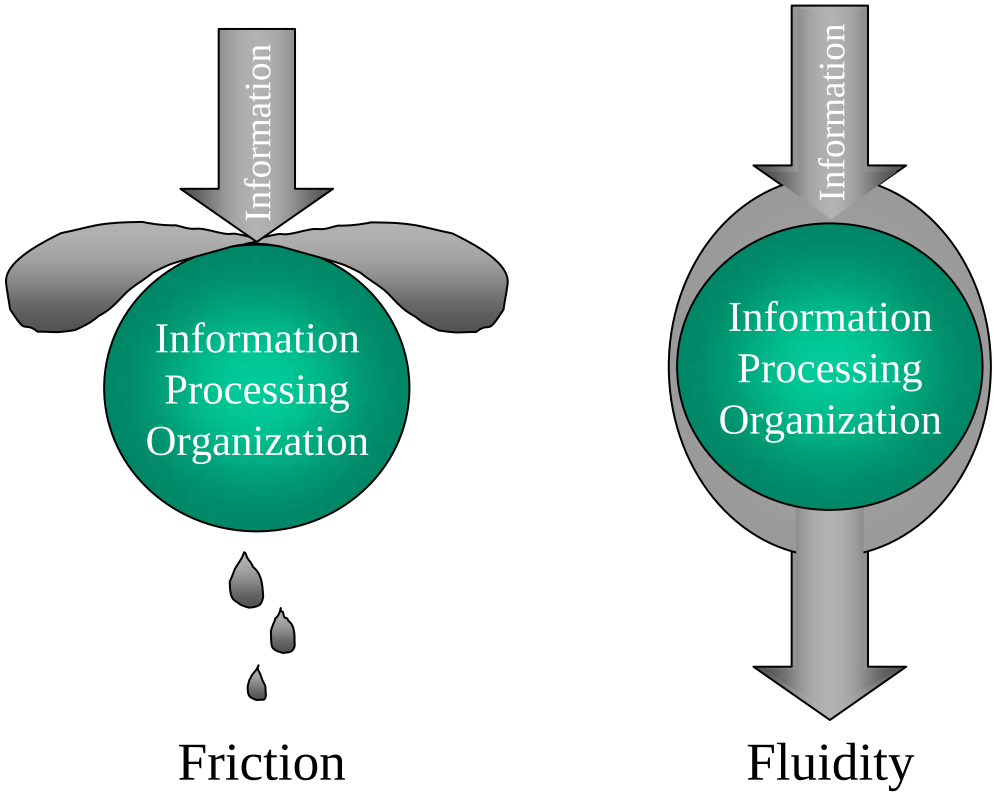
The Knowledge Pyramid



Solving the Puzzle



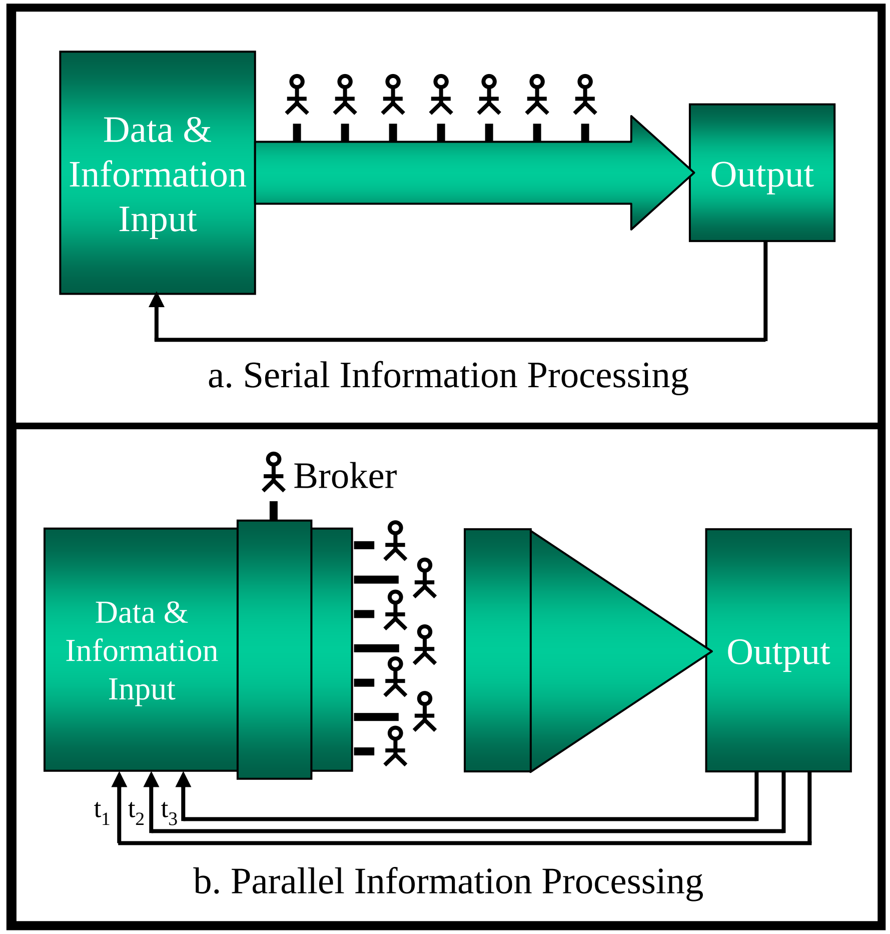
The Need for a Process Transformation



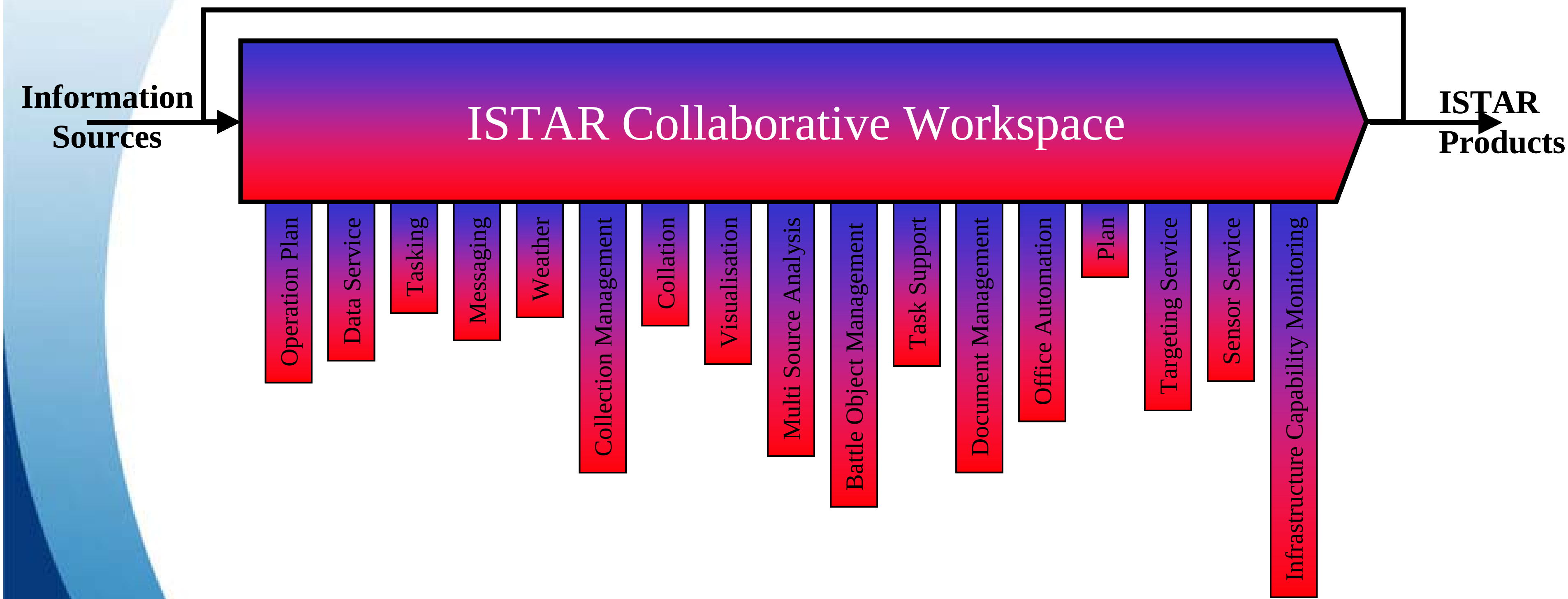
- The Process Transformation enables organizations to reengineer their information processes by removing friction while adding more fluidity.

Information Processing: Serial or Parallel

- Organizations employing information workers in parallel processing topology enabling collaborative sharing was proven to produce results of better quality and quantity than with the serial processing topology.



The Information Centric Workspace



The Ingredients for "Systems" Transformation

Function

Tasks

Vision

Method

Tools

Fusion

Approach

Process

Collection Management

Position

Concepts

Database

Network

Mobility

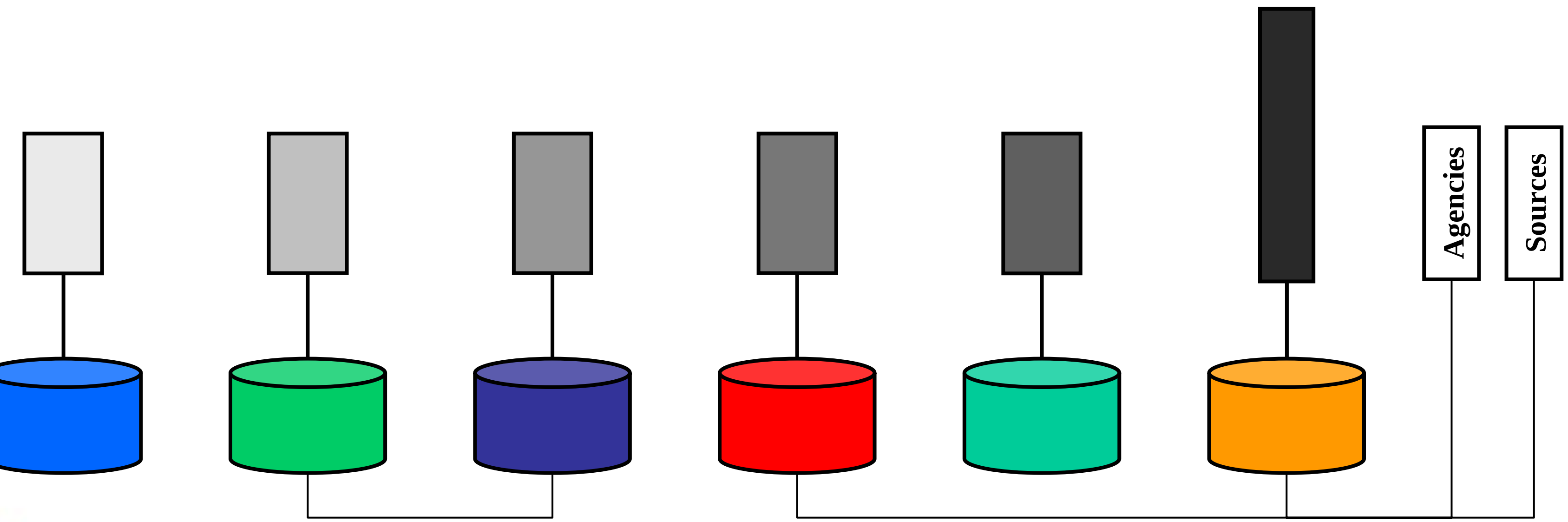
Parallel Processing

Collaborative

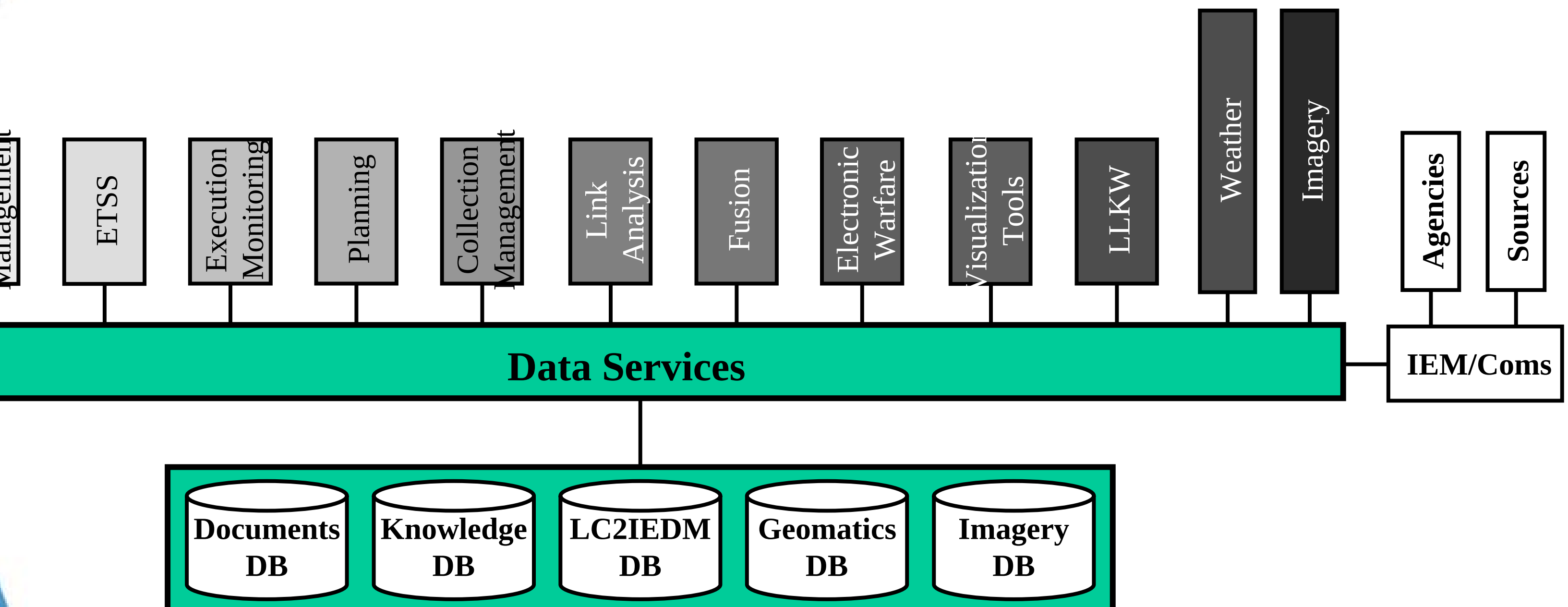
Warfare

Flexibility

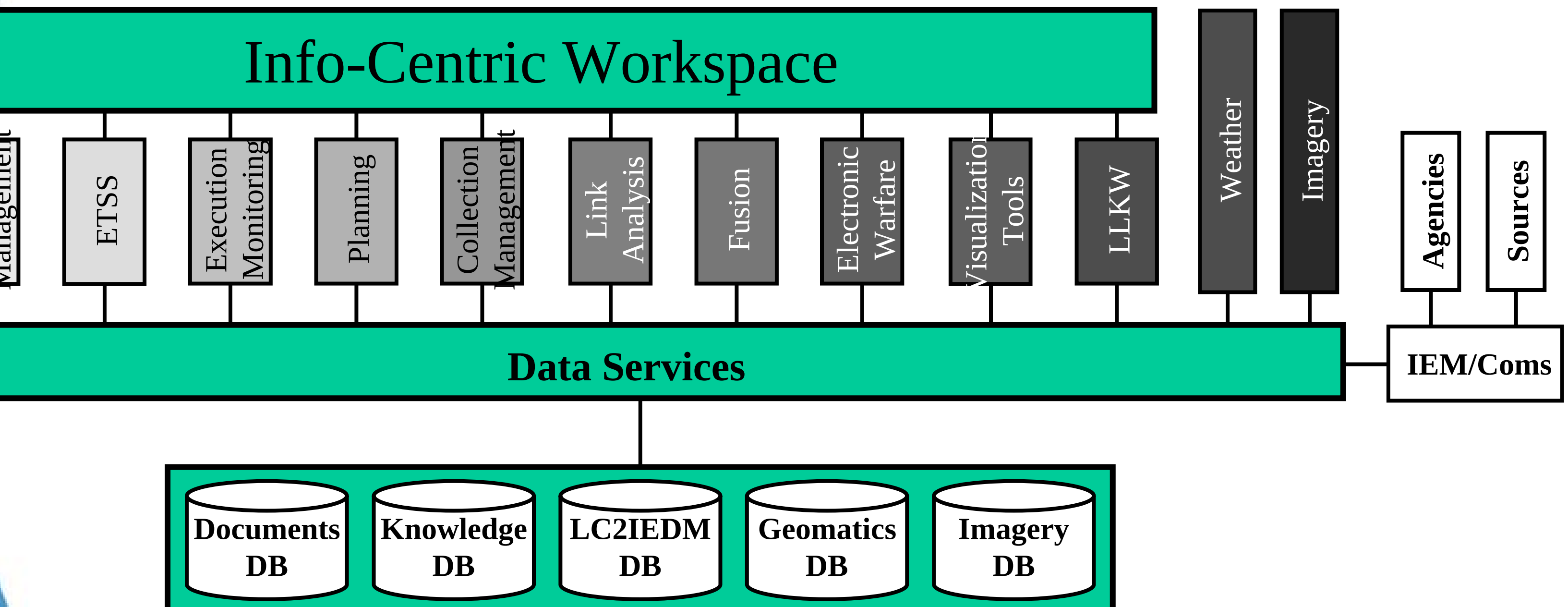
Systems Supporting Vertically Specialized Command and Control Functions



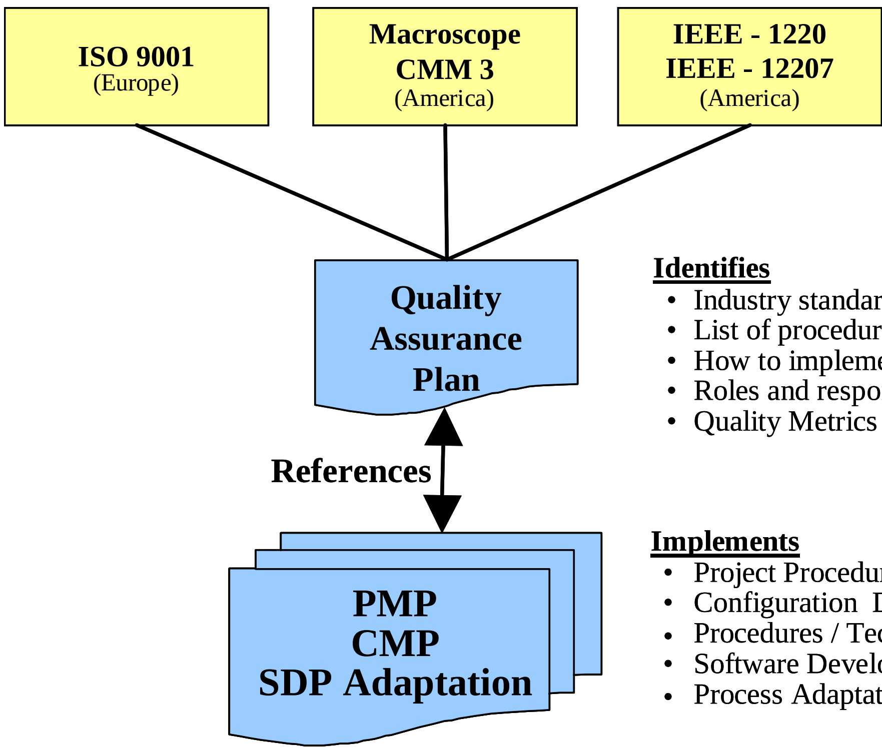
Operational Context Interoperability Achieved Through Common Reference Data Models



The proposed ISTAR Information Centric Workspace System of Systems Vision



Methodology and Approach

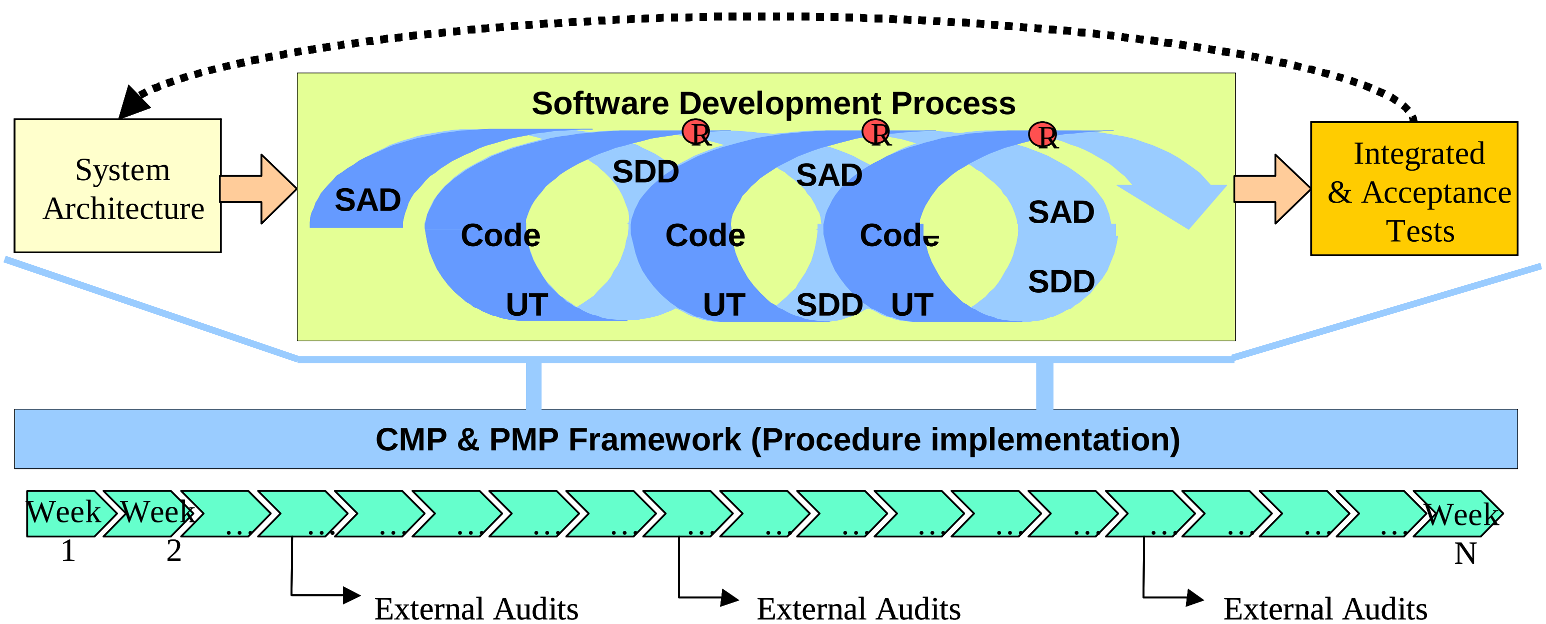


Identifies
- Industry standard requirements
- List of procedures to comply with
- How to implement it (Strategy)
- Roles and responsibilities
- Quality Metrics

Implements
- Project Procedures
- Configuration Development
- Procedures / Techniques
- Software Development
- Process Adaptation

Canadian ISTAR Project Adopted Methodology

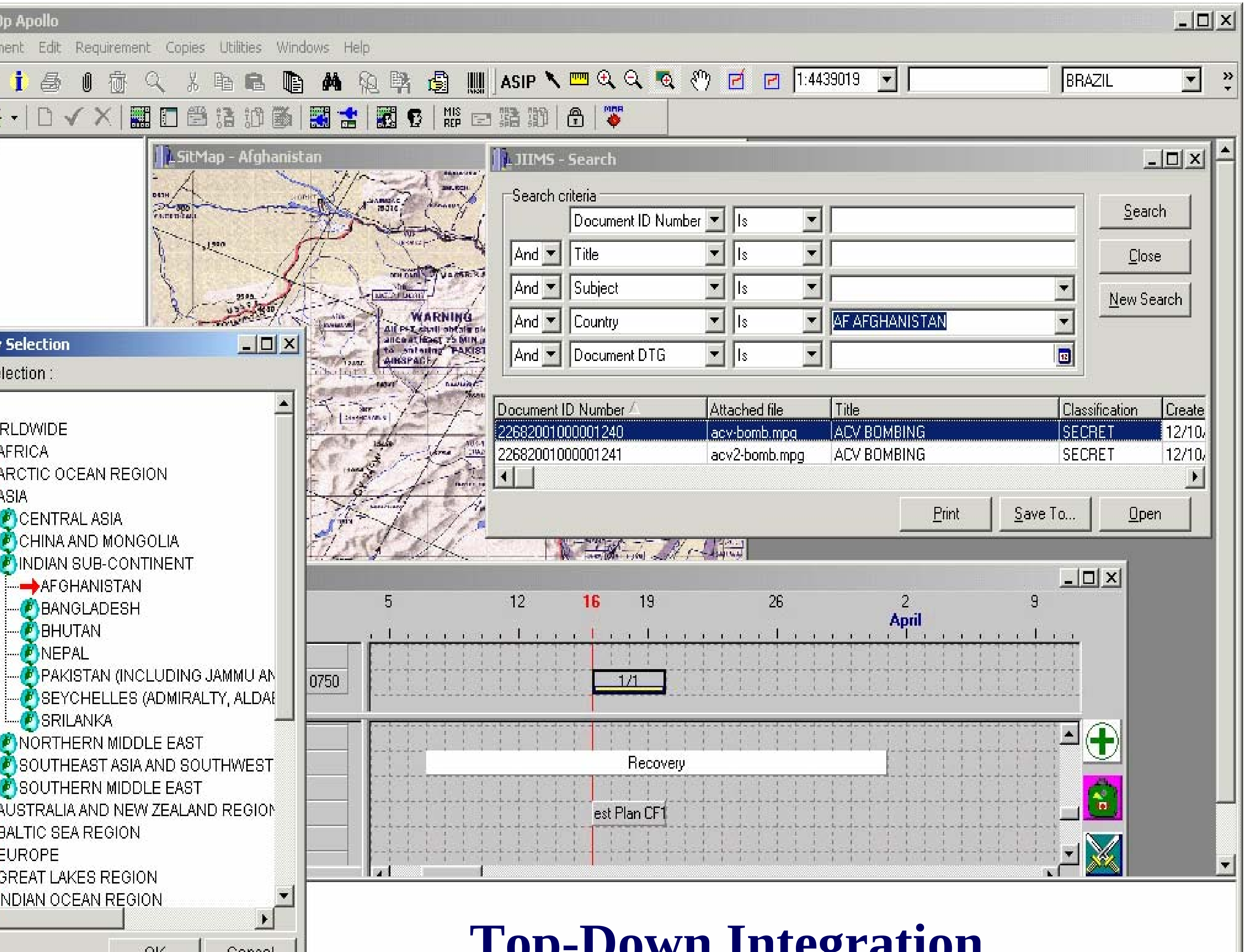
Methodology and Approach



Software Proto-Cycling Adopted Methodology

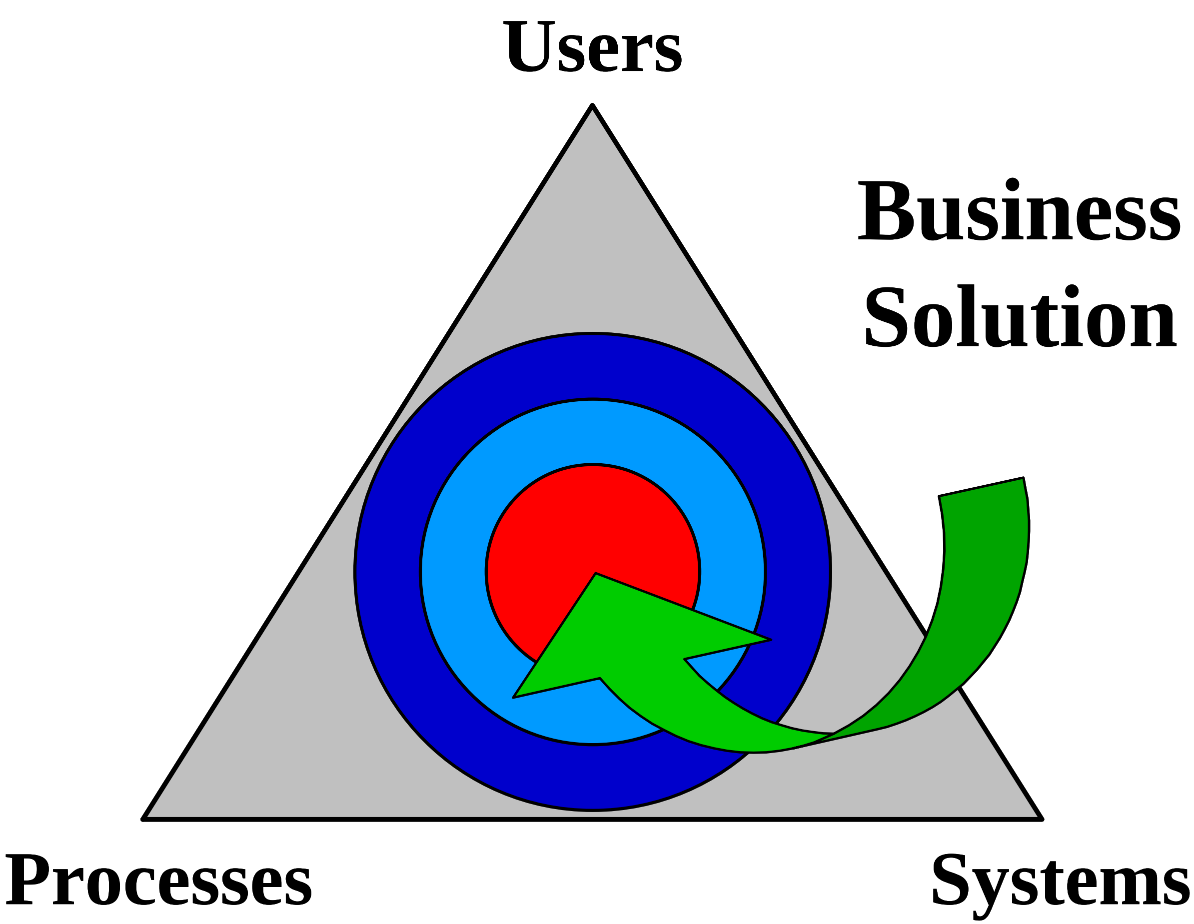
Lessons Learned: Transformation Ingredients in Processes and Systems Perspectives

- Develop an information business vision
- Develop a top-down “System of systems” architecture supporting the vision
- Adopt a data-centric vision with a common reference model
- Field a distributed network-centric capability and
- Embark on an information-centric workspace system approach



Top-Down Integration

Conclusion



Questions?